

Geostationary Lightning Mapper: Mapping lightning from space to save lives



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Mission

The GOES-R Geostationary Lightning Mapper (GLM) detects and maps “total lightning” (in-cloud and ground-to-cloud) from geostationary orbit and provides early indication of storm intensification and severe weather events. GLM is one of six instruments and a new capability on the Geostationary Operational Environmental Satellite-R Series (GOES-R) satellite, the next generation of geostationary weather satellites.

GLM lightning data provides forecasters with information to increase tornado warning times from ~ 14 minutes to greater than 20 minutes.



Figure 1. Street-level view before and two days after tornado (Joplin high school)¹

Lightning Jump Signature – lightning as an accurate tornado predictor

Studies show correlation between the increase in total flash rates within a storm to severe weather occurrence². The correlation is between updraft strength and modulation of electrification and updraft strength and ability to produce severe and hazardous weather. A rapid increase in lightning frequency is associated with intensification of the storm updraft followed by a rapid decrease in lightning activity associated with a weakening updraft and eventual downdraft (Fig. 2).

Current national average for tornado warning lead-time is only 14 minutes; GLM will increase the warning lead time to more than 20 minutes².

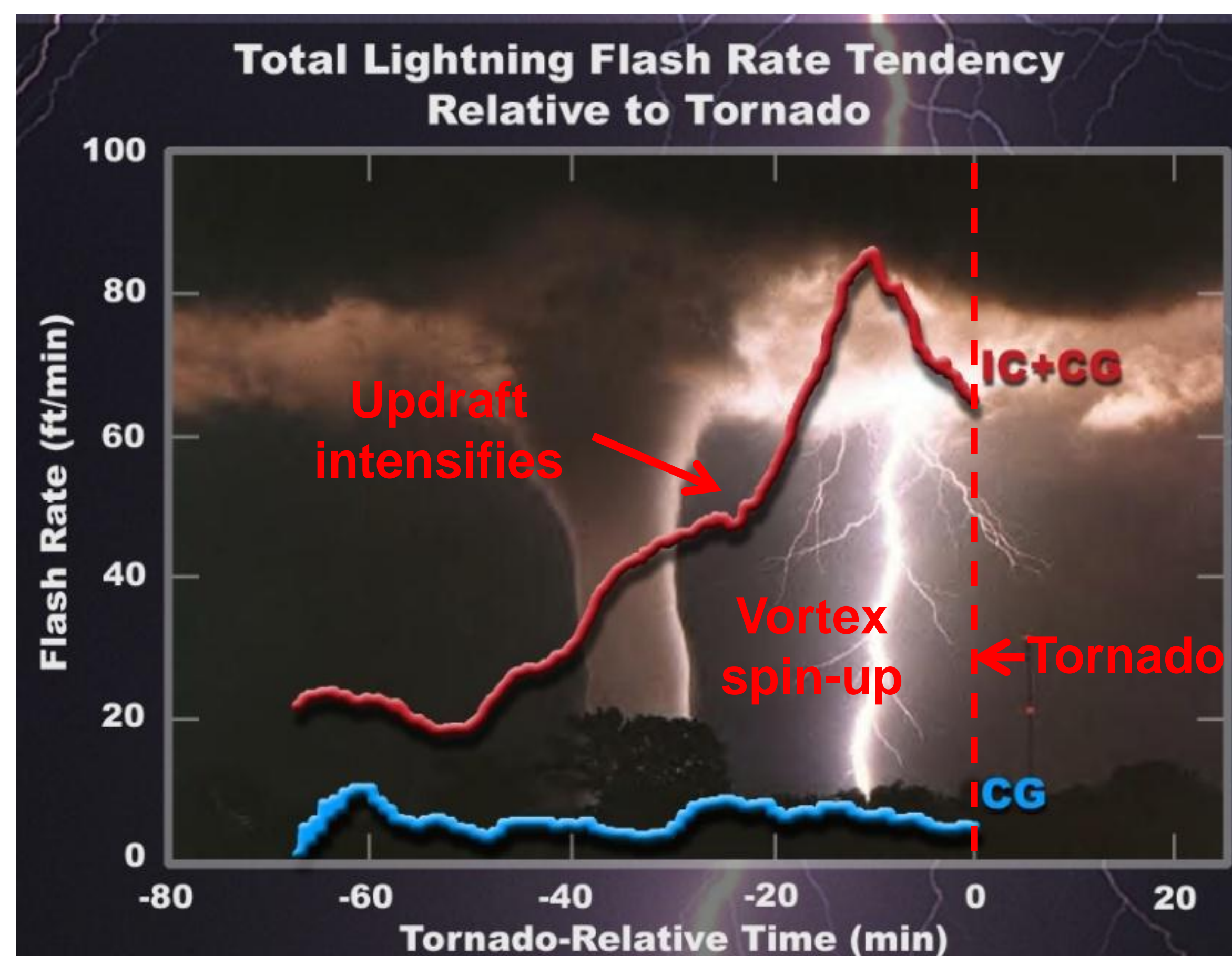


Figure 2. Lightning “jump” signature

GLM Key Driving Requirements

Top-Level Requirements

- Capture 70% of the lightning flashes
- False alarm rate less than 5%

GLM Characteristics

- CCD event detector
 - 1.8 Megapixel focal plane
 - 500 frames per second
 - 777.4 nm wavelength
- Near uniform spatial resolution
 - 8 km (nadir) – 14 km (edge of FOV)
- Product availability <9 sec latency
- “Full-disk” field of view

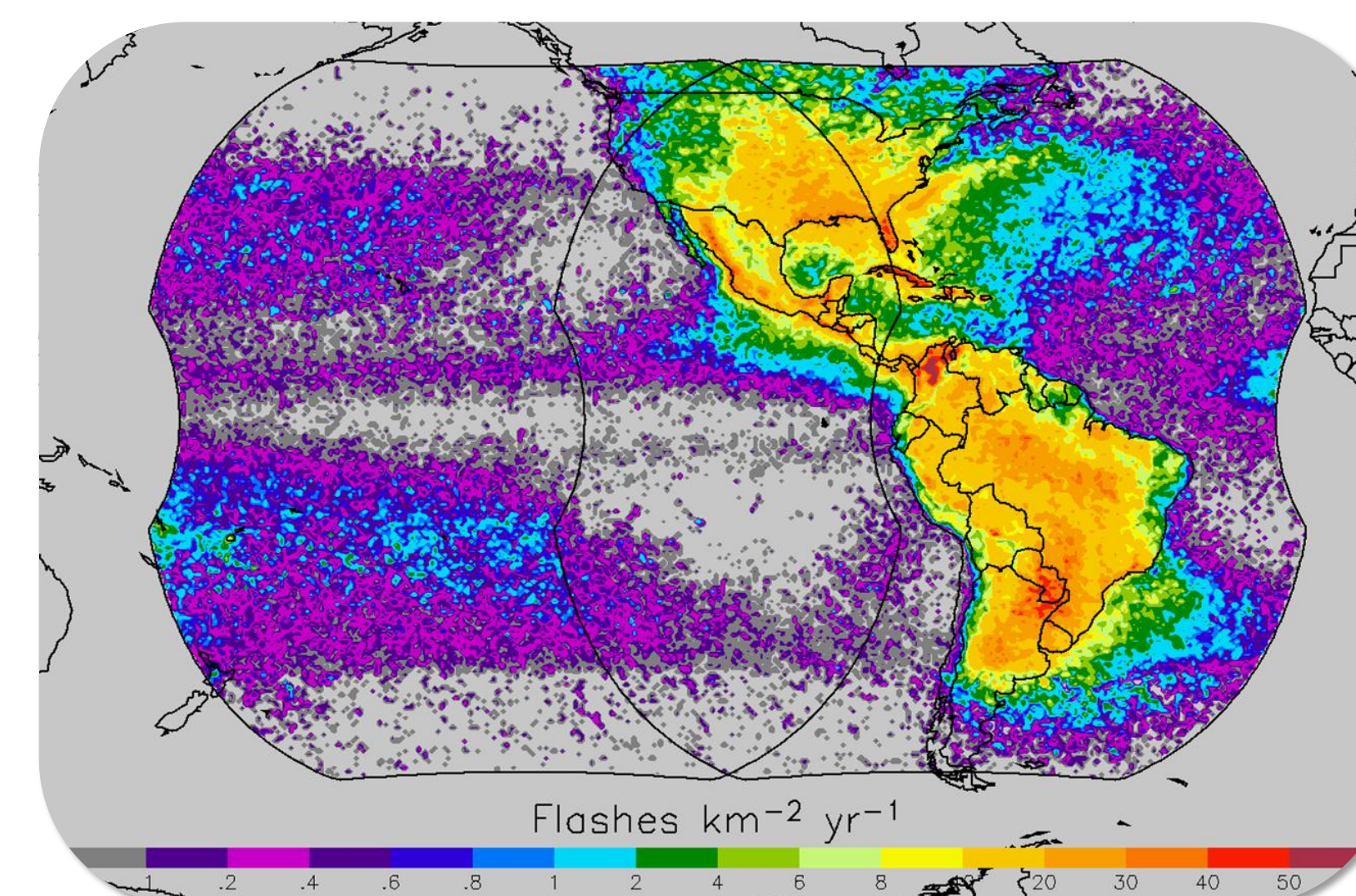


Figure 3. GLM full disk FOV overlaid on global distribution of lightning (Apr 1995 – Feb 2003; NASA OTD & LIS)

GLM is a near-IR detector that continuously maps total lightning with near uniform spatial resolution. In just two weeks of observations, GLM will gather more data than all other orbiting research sensors have in the past 10 years. Beyond saving lives by increasing tornado warning times, GLM data will be used to further understand climate change, warn aircraft pilots of strong turbulence, offer new insights into the evolution of storms and enable improvements in severe weather forecasting.

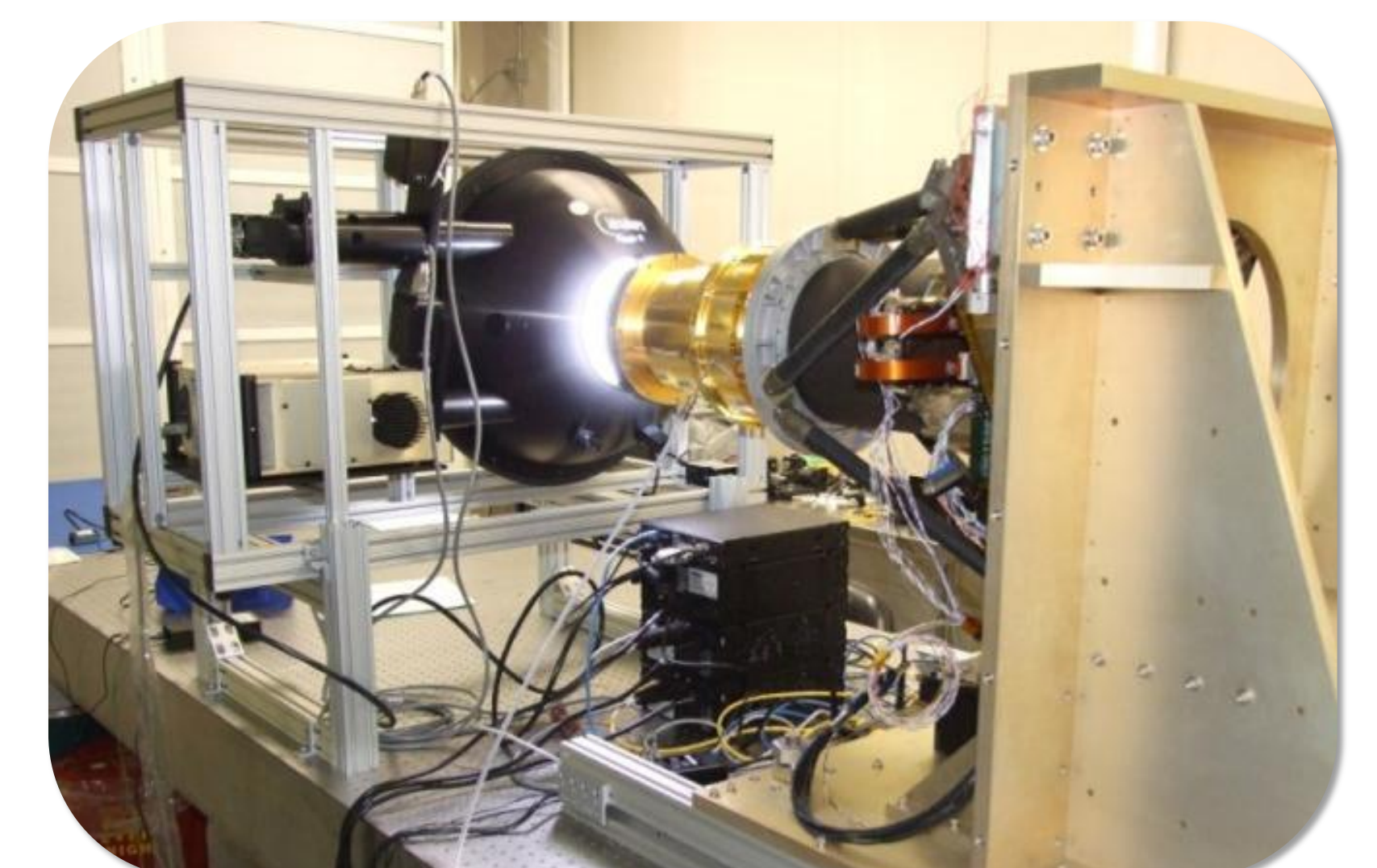
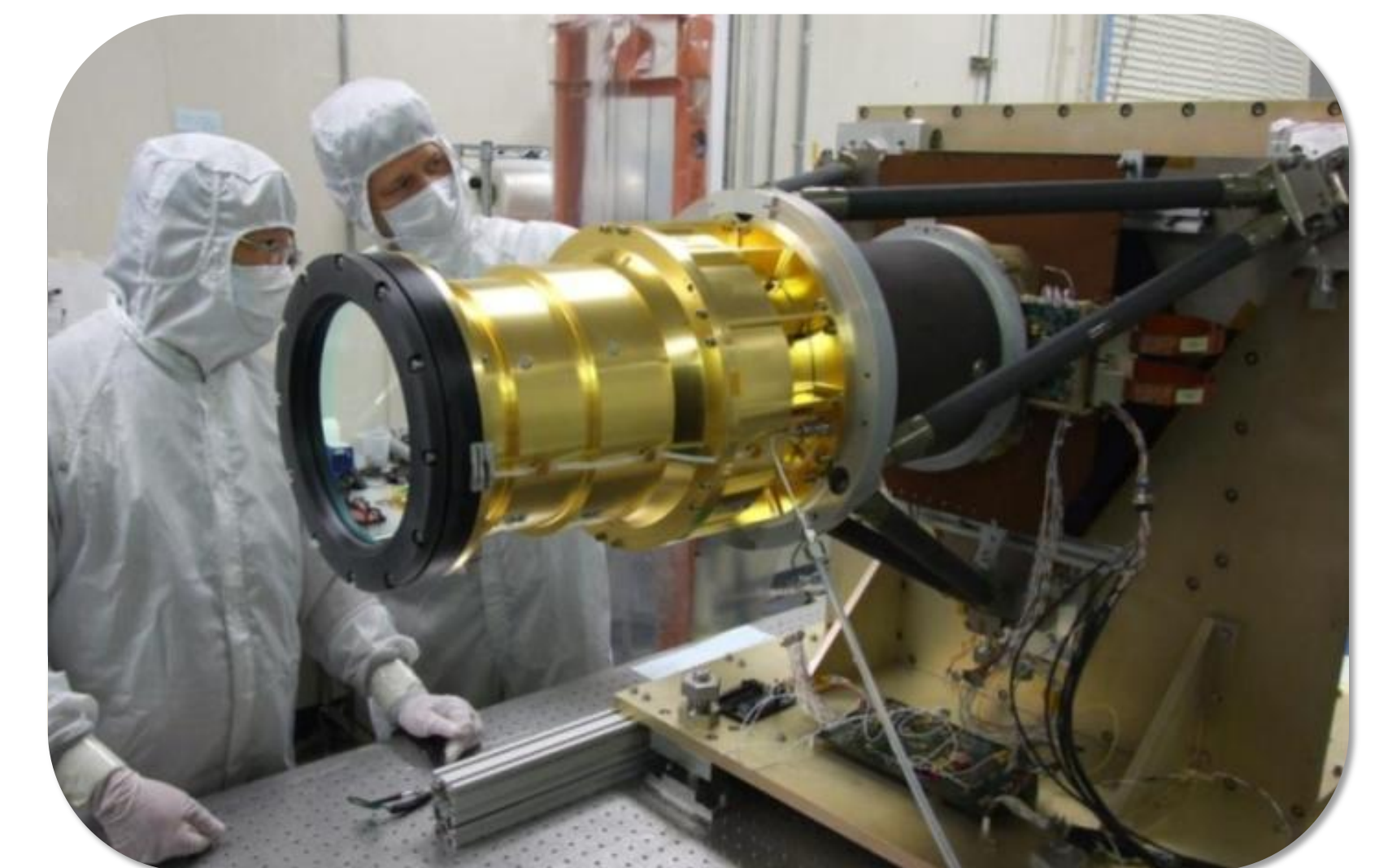
References

1. <http://www.npr.org/2011/05/26/136655052/before-and-after-a-birds-eye-view-of-joplin?ps=cp>
2. Goodman et al. 1988; Christian et al. 1989; Williams et al. 1989; Williams et al. 1999; Schultz et al. 2009; Gatlin and Goodman 2010

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Mission Objectives

- Longer tornado warning time
- Decadal lightning data
- Storm cell tracking



Figures 4 & 5. GLM Sensor Unit